Colonel Richard W. Gibbs, USAF  
Commander  
377th Air Base Wing  
2000 Wyoming Blvd SE  
Kirtland AFB NM 87117

Mr. John Kieling, Bureau Chief  
Hazardous Waste Bureau (HWB)  
New Mexico Environment Department (NMED)  
2905 Rodeo Park Drive East, Building 1  
Santa Fe NM 87505-6303

Dear Mr. Kieling,

Attached please find the Bioventing Respiration Pilot Testing Procedure for the Bulk Fuels Facility, Solid Waste Management Unit (SWMU) ST-106/SS-111, Kirtland Air Force Base, New Mexico, dated September 2018. This procedure has been prepared to summarize the field details of the testing approach approved in the Work Plan for Bioventing and Air-lift Enhanced Bioremediation Pilot Test, Bulk Fuels Facility, Solid Waste Management Unit (SWMU) ST-106/SS-111, Kirtland Air Force Base, New Mexico, dated November 2017.

If you have any questions or concerns, please contact Mr. Scott Clark at (505) 846-9017 or at scott.clark@us.af.mil or Mr. Sheen Kottkamp at (505) 846-7674 or at sheen.kottkamp.l@us.af.mil.

Sincerely,

RICHARD W. GIBBS, Colonel, USAF  
Commander

cc:
NMED (Borrego) letter  
NMED-OOTS (McQuillan), letter and CD  
NMED GWQB (Hunter), letter and CD  
EPA Region 6 (King, Ellinger), letter and CD  
SAF-IEE (Lynnes), electronic only  
AFCEC/CZ (Renaghan, Clark, Kottkamp, Segura), electronic only  
USACE-ABQ District Office (Moayyad, Phaneuf, Dreeland, Cordova, Salazar), electronic only  
Public Info Repository, Administrative Record/Information Repository (AR/IR) and File
Bioventing Respiration
Pilot Testing Procedure

Revision 0
September 2018
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ATTACHMENTS

Attachment A – Well Construction Diagrams
Attachment B – Field Forms
Attachment C – Manufacturer’s Specifications
## DOCUMENT REVISION HISTORY

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<td>Dr. Rob Hinchee</td>
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1. SCOPE AND APPLICATION

The bioventing respiration pilot test, field data collection, and analytical laboratory sample collection methodology are described in the following document. The area where the bioventing respiration pilot test will be performed is shown on Figure 1. The field area and test wells for the bioventing respiration pilot test are shown on Figure 2.

The bioventing respiration testing will allow for verification of the design parameters estimated in the respiration testing. Data collected from the testing will assist with the assessment of the sustainability of biodegradation rates over a longer period of time. Three tests are envisioned: (1) “dry” respiration tests, wherein ambient air is vented into the impacted zone in sufficient quantity to measure oxygen utilization (i.e., decline in oxygen content of “test cell,” by bacterial respiration); (2) “moist” respiration test wherein water is added to the subsurface to stimulate bacteria, and oxygen utilization measured; and (3) a long-term bioventing test wherein multiple wells are vented simultaneously for more than a year and respiration is monitored in observation wells at a distance.

The test layout, test wells, bioventing equipment and instrumentation, measurement of field parameters, and analytical chemistry regimen are discussed herein and provided in the figures, tables, and attachments. Design parameters obtained during the respiration test shall be utilized to design the long-term bioventing pilot test.

2. BIOVENTING TEST WELLS

The respiration testing utilizes nine existing soil vapor extraction wells and soil vapor monitoring (SVM) wells for air injection. Two new nested SVM wells will be installed to monitor pressure and subsurface parameters (Table 1). Well locations are shown on Figure 2. The new SVM wells (KAFB-106V1 and KAFB-106V2) include multiple screen depths to facilitate discrete vertical monitoring of the vadose zone. The designs for KAFB-106V1 and KAFB-106V2 bioventing observation wells are provided in Figures 3 and 4. KAFB-106V1 and KAFB-106V2 locations were specified for the long-term bioventing pilot test to be used as observation wells as the injection wells will be under continuous operation. These observations wells are intended for use during short-term respiration tests to obtain pressure measurements only. The respiration tests are designed to be “single well” tests.

The wells selected for air injection vary in size from 0.5 to 4 inches in diameter. Table 1 also provides radial distances from air injection wells to nearby existing wells suitable for use as observation wells during the long-term bioventing test. Completion diagrams for the existing air injection and observation wells are provided in Attachment A.

The construction details, diameters, and open intervals for the designated air injection wells are provided in Table 2, along with the air injection rate and nominal pipe velocity. Test cell pore volume is calculated using a filter pack length (plus 5 feet above and below to account for leakage) and a control radius of 15 feet. The control radius is the radial distance from the injection well to the edge of the cylindrical test cell. The control radius is utilized to establish the
test cell pore volume, and thus the volume of air to be injected. The test cell volume is expected to be large enough so that sampling subsequent to air injection will measure only oxygen depletion in injected air, not ambient soil vapor which could intrude into the test cell.

3. BIOVENTING INSTRUMENTATION

Air will be injected with a blower capable of 50 cubic feet per minute (cfm) at 3 psi. The unit will be plumbed and configured for use in injection mode. A piping and instrumentation diagram of the air injection test equipment is provided as Figure 5. Other features of the bioventing system include:

- Direct reading rotameters and pressure gauges that control flow rates on individual manifold legs and the header
- Schedule 80 polyvinyl chloride header and manifold
- One-inch diameter compressed air hose conveyance line that will connect the blower to the header
- Quick-connect fittings at the manifold and wellheads to facilitate air injection or well sampling
- Electrical service providing 120-volt single phase power, as well as a 230-volt, 3-phase power connection.

4. PROCEDURE

4.1 DRY RESPIRATION TEST

“Dry” respiration tests consist of the injection of ambient air into a well sufficient to achieve the estimated pore volume of air (porosity assumed to be 35 percent [%]). A 15-foot radius from the injection well is assumed for the calculation of each test cell control volume. The thickness of each test cell control volume is equal to the filter pack length, plus 5 feet above and below to account for vertical air flow. The injection rate is calculated based on the addition of four pore volumes of the test cell in each well. Injection rates for each well are provided in Table 2. Air injection is monitored and controlled using rotameters located at the injection wellhead. Injection flow rates and pressure are recorded at each well. Injection will occur at all well locations simultaneously. The injection periods is expected to last 3 days. If injection rates are lower than anticipated, the injection duration will be increased to maintain the specified volume of injection air.

During the air injection phase of the tests, pressure radius of influence (ROI) monitoring is performed using nearby wells not used for injection (see Table 1). If pressures can be measured, then estimates of pressure ROI monitoring provide an estimate of both the soil and soil vapor.
permeability and the ROI to which pressure can be measured. A digital monometer capable of detecting 0.1 inches of water column is used to monitor the pressure response at the nearby wells to establish the ROI. However, given the permeable nature of the soil and distances to monitoring points, measurable pressure may not be found. ROI will also be estimated utilizing the respiration test data based on oxygen demand.

After the air is injected, field parameter readings for water activity, pressure, carbon dioxide, oxygen, total petroleum hydrocarbons, methane, flow rate, and temperature are collected in accordance with frequency indicated in Table 3. Soil vapor samples are collected using the method described in the approved work plan (U.S. Army Corps of Engineers [USACE], 2017) and submitted to Eurofins Air Toxics, Inc. (EAT), Folsom, California for the analytes listed in Table 4. A piping and instrumentation diagram of the soil vapor sampling setup is provided in Figure 6.

4.2 MOIST RESPIRATION TEST

After the “dry” respiration tests have been completed, water is injected into each test well under pressure (to the degree practicable). The water is radially forced into the formation. The specified amount of water added is 1% of the treatment cell pore volume. This volume of water is estimated to be (for a 15-foot radius and 35% porosity) equal to 2.5 cubic feet (19 gallons) per foot of treatment cell height. Thus, 2.5 cubic feet of water is added to a per foot unit test cell pore volume of 247 cubic feet. This relatively minimal volume is not anticipated to alter the formation geochemistry or cause contaminant migration.

The site soils are anticipated to have a relatively low initial moisture content and be generally sandy. The field capacity of sand varies from approximately 5-8%; therefore, the addition of 1% water is expected to be held in capillary tension and not drain down to a significant depth below the test cells. After the moisture is added, the test cells will be allowed to acclimate for a period of 4 weeks before the “moist” respiration tests are conducted in the same manner as described in Section 4.1 above.

5. DESIGN PARAMETER COLLECTION

5.1 FIELD PARAMETERS

Field measurements are made using hand-held portable meters as detailed in Table 3. The meters are inserted into ports installed into a 2-foot-long × 4-inch diameter clear polyvinyl chloride (PVC) cell. The PVC cell will be utilized to allow the use of multiple probes at a single time. The relative humidity probe shall be placed at the cell entrance, within the vapor stream to induce turbulence and promote mixing of the vapors within the cell. Measurements are taken during purging. Purging is performed with a high vacuum, low flow Gast diaphragm pump rated at 1.0-1.7 cubic feet per minute. Wells are purged until oxygen stabilizes; however, no less than three casing volumes plus the volume of any sampling tubing are removed before recording final field meter measurements. Stabilization is defined as less than a 10% change between three consecutive readings. Data to be collected and the sampling frequencies for field measured
parameters are provided in Table 3. Data are recorded on the field forms provided in Attachment B. Manufacturer’s specifications for field equipment are provided in Attachment C.

5.2 SOIL VAPOR SAMPLING AND ANALYSIS

Samples for laboratory analyses are collected in accordance with Table 4. At least three casing volumes are purged from the vapor wells before sample collection. Table 4 provides a summary of analytical parameters, test methods, number of samples, data use, and frequency of testing. Sample collection methodology and quality control generally follow the requirements in the Work Plan for SVM and Drinking Water Monitoring, Bulk Fuels Facility, Solid Waste Management Unit ST-106/SS-111 (USACE, 2018).

Analytical testing for vapor samples collected in support of the bioventing pilot test are performed by EAT. EAT maintains current Department of Defense Environmental Laboratory Accreditation Program certification for U.S. Environmental Protection Agency (EPA) Method TO-15 selective ion monitoring for volatile organic compounds; benzene, toluene, ethylbenzene, and xylenes and total petroleum hydrocarbons—gasoline range organics analyzed in accordance with EPA Method TO-3; and fixed gases (nitrogen, oxygen, hydrogen, carbon monoxide, and carbon dioxide) and C1 to C5 hydrocarbons in accordance with ASTM International Method D1945.

6. REFERENCES


## Bioventing Respiration Pilot Test Well Details and Function

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Notes:
1. Three types of treatability tests will be conducted: (1) single well "push-pull" respiration **without** moisture addition, (2) single well "push-pull" respiration **with** moisture addition, and long-term bioventing with multiple injection points operating in concert.
2. Observation wells will be used during respiration tests for pressure measurements and physical radius of influence only. During long-term bioventing test, observation wells will be used for respiration measurements as well.
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<th>Screen Length (ft)</th>
<th>Screen Diameter (in.)</th>
<th>Casing Volume (ft³)</th>
<th>Filter Pack Thickness (ft)</th>
<th>Assumed Venting Thickness (ft)</th>
<th>Test Cell Pore Volume (ft³)</th>
<th>Added Moisture Volume (gallons)</th>
<th>Air Injection Period (days)</th>
<th>Design Flow Rate (cfm)</th>
<th>Nominal Pipe Velocity (ft/min)</th>
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1 Vertical leakage into formation assumed 5 feet above and 5 below filter pack interval
2 Test cell design radius = 15 feet
3 Moisture added at 1% of pore volume
4 Assumed porosity = 35%
cfm = Cubic feet per minute
ft = Feet
ft³ = Cubic feet
ft bgs = Feet below ground surface
ft/min = Feet per minute
### Table 3
Bioventing Respiration Pilot Testing Field Measurement Equipment and Regimen

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Field Measurement</th>
<th>Media</th>
<th>Instrument&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Range/ Tolerance</th>
<th>Data Use</th>
<th>Respiration Test Frequency&lt;sup&gt;b&lt;/sup&gt;</th>
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<tr>
<td>Water Activity</td>
<td>Relative Humidity</td>
<td>Soil gas</td>
<td>Amprobe TH-3</td>
<td>0-100 % ± 3% R.H. at 23°C*</td>
<td>Determine relative humidity</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
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<td>Pressure/ Vacuum</td>
<td>Injection/ Extraction Pressure Distribution</td>
<td>Vadose zone</td>
<td>Dwyer 477-A7</td>
<td>0.05 inches water column</td>
<td>Evaluate pressure</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
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<td>Carbon Dioxide</td>
<td>Concentration in percent</td>
<td>Soil gas</td>
<td>Horiba</td>
<td>0-30% ± 0.3% by volume</td>
<td>Evaluate contaminant destruction rate</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Concentration in percent</td>
<td>Soil gas</td>
<td>Horiba</td>
<td>0-30% ± 0.1% by volume</td>
<td>Evaluate contaminant destruction rate</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
</tr>
<tr>
<td>Total Petroleum Hydrocarbons</td>
<td>Concentration in parts per million</td>
<td>Soil gas</td>
<td>Horiba</td>
<td>0-10,000 ppmv ± 10 ppmv</td>
<td>Evaluate soil vapor hydrocarbons</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
</tr>
<tr>
<td>Methane</td>
<td>Concentration in parts per million</td>
<td>Soil gas</td>
<td>Sensit PMD</td>
<td>0-5000 ppmv ± 10%</td>
<td>Evaluate contaminant destruction rate</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>Rotameter</td>
<td>Soil gas</td>
<td>Brooks 2520A4A37BNBN</td>
<td>0.3-3 scfm</td>
<td>Verify injection/purge rates</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
</tr>
<tr>
<td>Temperature</td>
<td>Temperature</td>
<td>Soil gas</td>
<td>Amprobe TH-3</td>
<td>-20-60°C ± 0.8°C</td>
<td>Evaluate temperature</td>
<td>Daily for first 3 days; days 5 and 7; biweekly thereafter</td>
</tr>
</tbody>
</table>

<sup>a</sup> Or engineer approved equivalent

<sup>b</sup> Schedule can be adjusted based on observed oxygen utilization rates; goal is 5-10 data points in early linear portion of oxygen decay curve

<sup>*</sup> C = Degrees Celsius

ppmv = Parts per million (by volume)

---

This range and tolerance are based on instrument performance. Due to temperature variation and condensation, the actual field measurements will be less accurate. Test will be terminated when oxygen percent measurements have five linear points and/or oxygen is less than 5 percent.

* C = Degrees Celsius

ppmv = Parts per million (by volume)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Method</th>
<th>Media</th>
<th>No. of Samples Per Event</th>
<th>Sample Container</th>
<th>Data Use</th>
<th>Respiration Test Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTEX/TPH-GRO</td>
<td>EPA TO-3</td>
<td>Soil Vapor</td>
<td>12</td>
<td>1-liter Summa canister</td>
<td>Evaluate soil vapor hydrocarbons</td>
<td>Baseline and end of test</td>
</tr>
<tr>
<td>VOCs</td>
<td>EPA TO-15 SIM</td>
<td>Soil Vapor</td>
<td>12</td>
<td>1-liter Summa canister</td>
<td>Evaluate soil vapor EDB concentrations</td>
<td>Baseline and end of test</td>
</tr>
<tr>
<td>Fixed Gases&lt;sup&gt;b&lt;/sup&gt;</td>
<td>ASTM D1945</td>
<td>Soil Vapor</td>
<td>12</td>
<td>1-liter Summa canister</td>
<td>Verify field instrument reading</td>
<td>Baseline and end of test</td>
</tr>
<tr>
<td>C1-C5 Hydrocarbon Compounds&lt;sup&gt;c&lt;/sup&gt;</td>
<td>ASTM D1945</td>
<td>Soil Vapor</td>
<td>12</td>
<td>1-liter Summa canister</td>
<td>Evaluate degradation of EDB</td>
<td>Baseline and end of test</td>
</tr>
</tbody>
</table>

<sup>a</sup> Soil vapor samples collected from each of the six nested wells in both KAFB-106V1 and KAFB-106V2 (does not include quality control samples)

<sup>b</sup> Fixed gases: nitrogen, oxygen, hydrogen, carbon monoxide, and carbon dioxide

<sup>c</sup> C1-C5 hydrocarbon compounds: methane, ethane, propane, butane, and pentane

ASTM = ASTM International  
BTEX = Benzene, toluene, ethylbenzene, and xylenes  
EDB = Ethylene dibromide (1,2-dibromoethane)  
EPA = U.S. Environmental Protection Agency  
GRO = Gasoline range organics  
SIM = Selective ion monitoring  
TPH = Total petroleum hydrocarbons  
VOC = Volatile organic compound
PILOT TESTING AREAS

FIGURE 1

BIOVENTING RESPIRATION PILOT TESTING PROCEDURE
BULK FUELS FACILITY
SOLID WASTE MANAGEMENT UNIT ST-106/SS-111
KIRTLAND AIR FORCE BASE, NEW MEXICO

Legend
- Existing Soil Vapor Well
- Proposed Bioventing Observation Well
- Former Buried Fuel Transfer Line
- Former Aboveground Fuel Transfer Line
- Bulk Fuels Facility
- (SWMU ST-106/SS-111)

Notes:
Aerial Imagery taken in May 2016 from New Mexico Mid-Region Council of Governments.
FIGURE 3: NESTED SOIL VAPOR WELL COMPLETION DIAGRAM FOR KAFB-106V1

GROUND SURFACE ELEVATION 5343.25 FT AMSL

SAMPLE PORT

MANHOLE COVER
WELL VAULT
SLOPING WELL PAD
CONCRETE SEAL

10" BOREHOLE

3/4" SCHEDULE 80 PVC
SCREEN (0.020 SLOT)

TOTAL DEPTH 275 FT BGS (5008.25 FT)

TOP OF SCREEN 1
270.0 FT BGS (5073.25 FT)
BOTTOM OF SCREEN 1
272.5 FT BGS (5070.75 FT)

TOP OF SCREEN 2
250.0 FT BGS (5086.25 FT)
BOTTOM OF SCREEN 2
252.5 FT BGS (5086.75 FT)

TOP OF SCREEN 3
215.0 FT BGS (5186.25 FT)
BOTTOM OF SCREEN 3
217.5 FT BGS (5187.75 FT)

TOP OF SCREEN 4
157.5 FT BGS (5165.75 FT)
BOTTOM OF SCREEN 4
160.0 FT BGS (5163.25 FT)

TOP OF SCREEN 5
115.0 FT BGS (5288.25 FT)
BOTTOM OF SCREEN 5
117.5 FT BGS (5225.75 FT)

TOP OF SCREEN 6
100.0 FT BGS (5243.25 FT)
BOTTOM OF SCREEN 6
102.5 FT BGS (5240.75 FT)

(ELEVATION) IS IN ABOVE MEAN SEA LEVEL
AMS = ABOVE MEAN SEA LEVEL

NOT TO SCALE
BGS = BELOW GROUND SURFACE
FT = FEET
FIGURE 4: NESTED SOIL VAPOR WELL COMPLETION DIAGRAM FOR KAFB-106V2

HYDRATED GRANULAR BENTONITE
BOTTOM OF BENTONITE INTERVAL
99.5 FT BGS (3243.75 FT)

HYDRATED GRANULAR BENTONITE
BOTTOM OF BENTONITE INTERVAL
114.5 FT BGS (3228.75 FT)

HYDRATED GRANULAR BENTONITE
BOTTOM OF BENTONITE INTERVAL
157.0 FT BGS (5186.25 FT)

HYDRATED GRANULAR BENTONITE
BOTTOM OF BENTONITE INTERVAL
214.5 FT BGS (5128.75 FT)

HYDRATED GRANULAR BENTONITE
BOTTOM OF BENTONITE INTERVAL
249.5 FT BGS (5093.75 FT)

HYDRATED GRANULAR BENTONITE
BOTTOM OF BENTONITE INTERVAL
269.5 FT BGS (5073.75 FT)

10/20 SAND (TYP.)
BOTTOM OF SAND INTERVAL
103.0 FT BGS (3240.25 FT)

10/20 SAND (TYP.)
BOTTOM OF SAND INTERVAL
118.0 FT BGS (3229.25 FT)

10/20 SAND (TYP.)
BOTTOM OF SAND INTERVAL
160.5 FT BGS (5182.75 FT)

10/20 SAND (TYP.)
BOTTOM OF SAND INTERVAL
218.0 FT BGS (5125.25 FT)

10/20 SAND (TYP.)
BOTTOM OF SAND INTERVAL
253.0 FT BGS (5090.25 FT)

10/20 SAND (TYP.)
BOTTOM OF SAND INTERVAL
275.0 FT BGS (5068.25 FT)

SAMPLE PORT
GROUND SURFACE ELEVATION
5343.25 FT AMSL

NOT TO SCALE

BGS = BELOW GROUND SURFACE
ASML = ABOVE MEAN SEA LEVEL

(ELEVATION) IS IN ABOVE MEAN SEA LEVEL

FT = FEET

PAGE 2 OF 2
P1: PRESSURE GAUGE, 0-25 PSI (GRAINGER MODEL: 4FLT8 OR APPROVED EQUIVALENT)
F1: ROTAMETER, 1-10 SCFM (BROOKS MODEL: 2530A4A65SVVT OR APPROVED EQUIVALENT)

NOTE: ALL PIPE FITTING ARE SCH. 80 PVC UNLESS OTHERWISE STATED.
RO TAMETERS ARE EQUIPPED WITH A FLOW CONTROL VALVE.
P1 : PRESSURE GAUGE, 0-200 IWC (Dwyer 477 Digital Manometer)
S1 : ANALYTICAL SAMPLE PORT
FG1 : FIXED GASES MONITORING PORT
RH1 : RELATIVE HUMIDITY AND TEMPERATURE MONITORING PORT
HC1 : TOTAL PETROLEUM HYDROCARBON MONITORING PORT
F1 : ROTAMETER, 0.3-3 SCFM (Brooks Model: 2520A4A37BNBN or Approved Equivalent)

NOTE: VAPOR CELL SHALL BE CONSTRUCTED OF CLEAR, SCH 40 PVC

CONVEYANCE LINE SHALL CONSIST OF ⅔ FEB TUBING
ROTAMETERS ARE EQUIPPED WITH A FLOW CONTROL VALVE.
ATTACHMENTS
Attachment A – Well Construction Diagrams
1- Ground elevation at well
   Approximately 5330'

2- Top of casing elevation a) vent hole? NA
   b) wellhead protection cover type 12" flush mount, locking caps
      a) weep hole? NA
      b) concrete pad dimensions 4" square flush mount

3- Dia./Type of well casing 4" Stainless Steel

4- Type/slot size of screen 4" Stainless Steel
   0.050" slot

5- Type screen filter 8x12 size sand, Colorado Silica Sand
   28x50lb sacks

6- Type of seal Environplug 3/8" Bentonite Chips
   9x50lb sacks

7- Surface Seal
   a) Grout mix used Environplug Bentonite Slurry
   b) Method of placement Pump
   c) Vol. of well casing grout NA

Development method NA
Development time NA
Estimated purge volume NA

Comments 5' sump below screen.

Illustration not to scale.
SOIL VAPOR EXTRACTION WELL COMPLETION DIAGRAM

1- Ground elevation at well: approximately 5340' 
2- Top of casing elevation: NA
3- Wellhead protection cover type:
   a) chain link: NA
   b) concrete pad dimensions: NA
4- Dia/Type surface casing: None
5- Dia/Type of well casing:
   2" Nom. CD Stainless Steel - Nested pair
6- Type/Isthmus of screen:
   2" Nom. CD Stainless Steel
   0.080 slot, 19' long
7- Type Screen Filter:
   6 x 12 Oglebay Colorado Silica
   19 x 100 lb Sacks
8- Type of seal:
   Hydrated Enviroplug 3/8" (medium)
   Bentonite chips - 74 x 50 lb Sacks
9- Grout:
   a) Grout mix used: Volclay Bentonite Grout - 43 x 50 lb Sacks
   b) Method of placement: Grout Pump
   c) Vol of surface casing grout: NA
   d) Vol of well casing grout: NA
Development method: NA
Development time: NA
Estimated purge volume: NA

Comments:

SVEW-03 is the deeper well with a screened interval of 145' - 160'
SVEW-02 is the shallower well with a screened interval of 45' - 60'

Illustration not to scale.
SOIL VAPOR EXTRACTION WELL COMPLETION DIAGRAM

1- Ground elevation above well (approximately 5340')
2- Top of casing elevation (NA)
3- Wellhead protection cover type (None)
   a) Drain tube (NA)
   b) Concrete pad dimensions (NA)
4- Dia./Type surface casing (NA)
5- Dia./Type of well casing (2" Nom. OD Stainless Steel - Nested pair)
6- Type/Size/Size of screen (6 x 12 Ogletroy Colorado Silica)
    Quantity used (34 x 100 lb Sacks)
7- Type screen filter (Hydrated Enviroplug 3/8" (medium))
    Quantity used (Bentonite chips - 96 x 50 lb Sacks)
8- Type of seal (Volkley Bentonite Grout - 50 x 50 lb Sacks)
7- Method of placement (Grout Pump)
9- Grout mix used
   a) Method of placement (Volkley Bentonite Grout - 50 x 50 lb Sacks)
   b) Vol. of surface casing grout (NA)
   c) Vol. of well casing grout (NA)
Development method (NA)
Development time (NA)
Estimated purge volume (NA)

Comments

SVEW-05 is the deeper well with a screened interval of 445' - 460'
SVEW-04 is the shallower well with a screened interval of 298' - 313'

Illustration not to scale.
SOIL VAPOR WELL COMPLETION DIAGRAM

1- Ground elevation at well
   approximately 5335'

2- Top of casing elevation
   NA

3- Wellhead protection cover type
   a) drain tube
   b) concrete pad dimensions
   None
   4" square flush mount

4- Dia./Type of casing
   Dia./Type of well casing
   1/2" Nom. OD Schedule 80 PVC w/ball valve

5- Dia./Type of well casing
   1/2" Nom. OD Schedule 80 PVC
   0.550 x 0.125, 2 1/2' long

6- Type/slot/size of screen
   6 - 12 Oglebay Colorado Silica
   50 x 50 lb sacks

7- Type screen filter
   quantity used
   Hydrated Envelop 24/48 (medium)
   bentonite chips - 116 x 50 lb sacks

8- Type of seal
   quantity used
   Portland Cement
   Pump

9- Grout
   a) Grout mix used
   b) Method of placement
   c) Vol. of surface casing grout
   d) Vol. of well casing grout
   Development method
   Development time
   Estimated purge volume
   NA
   NA
   NA

Comments:
Each of the four 1/2" wells is labelled with a small metal plate attached with a hose/cable by a small metal chain

Illustration not to scale.
SOIL VAPOR WELL COMPLETION DIAGRAM

1. Ground elevation at well: approximately 5300'
2. Top of casing elevation: NA
3. Wellhead protection cover type:
   a) Drain tube: None
   b) Concrete pad dimensions: 4' square flush mount
4. Dilu. type surface casing: None
5. Dilu. type of well casing:
   1/2' Nom. CD Schedule 80 PVC w/ ball valve
6. Types & size of screen:
   1/4' Nom. CD Schedule 80 PVC
   0.005 slot, 2 1/2' long
7. Type screen filter quantity used:
   8 - 12 Ogobay Colorado Silica
   52 x 50 lb. sacks
8. Type of seal quantity used:
   Hydrated Environbag 3/8' (medium)
   Bentonite chips - 163 x 50 lb. sacks
9. Grout:
   a) Grout mix used: Portland Cement
   b) Method of placement: Pump
   c) Vol of surface casing grout:
   d) Vol of well casing grout: NA
   Development method: NA
   Development time: NA
   Estimated purge volume: NA

Comments
Each of the four 1/2" wells is labeled with a small metal plate attached
with a hose clamp by a small metal chain.

Illustration not to scale.
SOIL VAPOR WELL COMPLETION DIAGRAM

1. Ground elevation at well: approximately 5339'
2. Top of casing elevation: NA
3. Wellhead protection cover type:
   a) drain tube? None
   b) concrete pad dimensions: 4' square flush mount
4. Dia./type surface casing: None
5. Dia./type of well casing: 1 1/2" Nom. OD Schedule 80 PVC w/tail valve
6. Type/size of screen:
   a) 1 1/2" Nom. OD Schedule 80 PVC
   b) 0.050 sscl, 2 1/2' long
7. Type screen filter quantity used:
   a) 8 - 12 Oglesby Colorado Silica
   b) 55 x 50 lb sacked
8. Type of seal quantity used:
   a) Hydrated Enviroplug 3/16" (medium)
   b) Bentonite chips - 201 x 50 lb sacked
9. Grout:
   a) Grout mix used: Portland Cement
   b) Method of placement: Pump
   c) Vol. of surface casing grout
   d) Vol. of well casing grout
Development method: NA
Development time: NA
Estimated purge volume: NA

Comments:
Each of the four 1/2" wells is labelled with a small metal plate attached with a hoseclamp by a small metal chain.

Illustration not to scale.
Not to Scale

BGS = Below Ground Surface
Nested Soil Vapor Well Completion Diagram
Map View for KAFB-106114

Top of Well Vault Elevation: 5,344.9 (ft)
Northing: 1,473,062.62
Easting: 1,541,796.54

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Well Diameter (in)</th>
<th>Well Depth (ft BGS)</th>
<th>Screened Interval (ft BGS)</th>
<th>Northing</th>
<th>Easting</th>
<th>Elevation (ft AMSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAFB-106114-25</td>
<td>3/4</td>
<td>25.0</td>
<td>15.0 - 25.0</td>
<td>1,473,062.35</td>
<td>1,541,796.49</td>
<td>5344.6</td>
</tr>
<tr>
<td>KAFB-106114-50</td>
<td>3/4</td>
<td>50.0</td>
<td>40.0 - 50.0</td>
<td>1,473,062.13</td>
<td>1,541,796.24</td>
<td>5344.6</td>
</tr>
<tr>
<td>KAFB-106114-150</td>
<td>3/4</td>
<td>150.0</td>
<td>140.0 - 150.0</td>
<td>1,473,061.84</td>
<td>1,541,796.37</td>
<td>5344.6</td>
</tr>
<tr>
<td>KAFB-106114-245</td>
<td>3/4</td>
<td>245.0</td>
<td>235.0 - 245.0</td>
<td>1,473,061.86</td>
<td>1,541,796.68</td>
<td>5344.6</td>
</tr>
<tr>
<td>KAFB-106114-350</td>
<td>3/4</td>
<td>350.0</td>
<td>340.0 - 350.0</td>
<td>1,473,062.17</td>
<td>1,541,796.71</td>
<td>5344.6</td>
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<tr>
<td>KAFB-106114-450</td>
<td>3</td>
<td>449.6</td>
<td>439.6 - 449.6</td>
<td>1,473,062.21</td>
<td>1,541,796.50</td>
<td>5344.6</td>
</tr>
</tbody>
</table>
Nested Soil Vapor Well Completion Diagram for KAFB-106116

Installation Start Date/Time: 3/7/2011 @ 08:15
Installation End Date/Time: 3/10/2011 @ 12:32

Ground Surface Elevation
5346.2 ft AMSL

Manhole Cover

Sample Port

Well Vault

Sloping Well Pad

Concrete Seal

10 ft BGS (5336.2 ft)

20 ft BGS (5326.2 ft)

50 ft BGS (5296.2 ft)

140 ft BGS (5206.2 ft)

150 ft BGS (5196.2 ft)

240 ft BGS (5106.2 ft)

250 ft BGS (5096.2 ft)

340 ft BGS (5006.2 ft)

350 ft BGS (4996.2 ft)

440 ft BGS (4906.2 ft)

450 ft BGS (4896.2 ft)

456 ft BGS (4890.2 ft)

Total Depth
456.0 ft BGS (4890.2 ft)
Nested Soil Vapor Well Completion Diagram for KAFB-106116

All Materials Placed with Tremie Pipe

BGS = Below Ground Surface
Top of Well Vault Elevation: 5346.5 (ft)
Northing: 1473297.03
Easting: 1541894.50

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Well Diameter (in)</th>
<th>Well Depth (ft BGS)</th>
<th>Screened Interval (ft BGS)</th>
<th>Northing</th>
<th>Easting</th>
<th>Elevation (ft AMSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAFB-106116-20</td>
<td>3/4</td>
<td>20.0</td>
<td>10.0 - 20.0</td>
<td>1473296.42</td>
<td>1541894.58</td>
<td>5346.0</td>
</tr>
<tr>
<td>KAFB-106116-50</td>
<td>3/4</td>
<td>50.0</td>
<td>40.0 - 50.0</td>
<td>1473296.44</td>
<td>1541894.90</td>
<td>5346.0</td>
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<tr>
<td>KAFB-106116-150</td>
<td>3/4</td>
<td>150.0</td>
<td>140.0 - 150.0</td>
<td>1473296.67</td>
<td>1541894.47</td>
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<tr>
<td>KAFB-106116-250</td>
<td>3/4</td>
<td>250.0</td>
<td>240.0 - 250.0</td>
<td>1473296.88</td>
<td>1541894.69</td>
<td>5346.0</td>
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<tr>
<td>KAFB-106116-350</td>
<td>3/4</td>
<td>350.0</td>
<td>340.0 - 350.0</td>
<td>1473296.72</td>
<td>1541894.97</td>
<td>5346.0</td>
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<tr>
<td>KAFB-106116-450</td>
<td>3</td>
<td>450.0</td>
<td>440.0 - 450.0</td>
<td>1473296.72</td>
<td>1541894.69</td>
<td>5346.0</td>
</tr>
</tbody>
</table>
Nested Soil Vapor Well Completion Diagram for KAFB-106128

Installation Start Date/Time: 3/7/2011 @ 11:40
Installation End Date/Time: 3/8/2011 @ 17:45

Seal 4: Planned Volume:______ Actual Volume:_____
Seal 5: Planned Volume:______ Actual Volume:_____
Seal 6: Planned Volume:______ Actual Volume:_____

3/4" Schedule 80 PVC Screen (0.050 slot)
10 ft

11-3/4" Borehole
120 feet BGS

3/4" Schedule 80 PVC Screen (0.050 slot)
10 ft

9-5/8" Borehole

3/4" Schedule 80 PVC Riser

3/4" Schedule 80 PVC Screen (0.050 slot)
10 ft

3" Schedule 80 PVC Riser

3/4" Schedule 80 PVC Screen (0.050 slot)
10 ft

3" Schedule 80 PVC Screen (0.050 slot)
10 ft

Total Depth
457.9 ft BGS (4885.9 ft)
Nested Soil Vapor Well Completion Diagram
Map View for KAFB-106128

Top of Well Vault Elevation: 5343.9 (ft)
Northing: 1473223.57
Easting: 1541619.74

<table>
<thead>
<tr>
<th>Well Number</th>
<th>Well Diameter (in)</th>
<th>Well Depth (ft BGS)</th>
<th>Screened Interval (ft BGS)</th>
<th>Northing</th>
<th>Easting</th>
<th>Elevation (ft AMSL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>KAFB-106128-25</td>
<td>3/4</td>
<td>25.0</td>
<td>15.0 - 25.0</td>
<td>1473223.25</td>
<td>1541619.61</td>
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<td>KAFB-106128-50</td>
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<td>50.1</td>
<td>40.1 - 50.1</td>
<td>1473222.98</td>
<td>1541619.50</td>
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</tr>
<tr>
<td>KAFB-106128-150</td>
<td>3/4</td>
<td>150.2</td>
<td>140.2 - 150.2</td>
<td>1473222.78</td>
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<td>250.3</td>
<td>240.3 - 250.3</td>
<td>1473222.92</td>
<td>1541619.98</td>
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<tr>
<td>KAFB-106128-350</td>
<td>3/4</td>
<td>350.4</td>
<td>340.4 - 350.4</td>
<td>1473223.25</td>
<td>1541619.92</td>
<td>5343.6</td>
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<td>KAFB-106128-450</td>
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<td>450.0</td>
<td>440.0 - 450.0</td>
<td>1473223.15</td>
<td>1541619.72</td>
<td>5343.6</td>
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</tbody>
</table>
### Time-Flowrate, Pressure, Volume Table

<table>
<thead>
<tr>
<th>Time</th>
<th>Flowrate (SCFM)</th>
<th>Pressure (PSI)</th>
<th>Volume (FT³)</th>
<th>Flowrate (SCFM)</th>
<th>Pressure (PSI)</th>
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**Notes:**
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<th>Flowrate (SCFM)</th>
<th>Vacuum (in-WC)</th>
<th>Volume (FT³)</th>
<th>VOC (ppmv)</th>
<th>O₂ (%)</th>
<th>CO₂ (%)</th>
<th>RH (%)</th>
<th>Temp (°F)</th>
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</tbody>
</table>

Notes:
Attachment C – Manufacturer’s Specifications
THWD-3 and TH-3
Relative Humidity and Temperature Meters
Contents

Relative Humidity Temperature Meters

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Specifications .......................................................................................................... 8
The THWD-3 and TH-3 are instruments to measure relative humidity and temperature. The extended probe allows the user to make measurements inside ducts or hard to reach areas. The Relative and MIN/MAX functions enable measurements to be made in two different areas and then compared. The large dual display and Data Hold function both make viewing the measurement results convenient. Both models utilize a capacitive sensor for humidity measure temperature in °C or °F with 0.1 %RH resolution. Both meters utilizes a capacitive sensor for humidity measurements up to 100% with a tenth percent resolution. With an auto power off feature to save battery life, protective cap for sensor life, vinyl carry case for transportation and battery installed, the TH-3 is the right choice for your atmospheric humidity measurement needs. Model THWD-3 has two extra features with the capability to also indicate Dew Point and Wet Bulb readings.

**Safety Information**
This meter has been designed and tested according to:
- EN50081-2
- EN50082-2

**Symbols Used in this Manual**

| ![Caution!](caution.png) | Caution! Refer to the explanation in this Manual |
| ![Caution!](caution.png) | Caution! Risk of electric shock |
| ![Conforms to relevant Australian standards](australian.png) | Conforms to relevant Australian standards |
| ![Complies with European Directives](europe.png) | Complies with European Directives |
| ![Power ON / OFF](power.png) | Power ON / OFF |
| ![Do not dispose of this product as unsorted municipal waste](waste.png) | Do not dispose of this product as unsorted municipal waste |
Operating Instructions

Power-Up

- Press the [0] key to turn the Humidity/Temperature meter ON or OFF.

Selecting Temperature Units

When the meter is first powered on, the default scale setting is set to the Celsius (°C) scale. To change to Fahrenheit (°F) press the [°F] button. Press again to revert to Celsius. The next time the meter is turned on, the scale setting will be the same as it was when you powered off last time.

Data-Hold Operation

The present reading may be held on the display by pressing the [HOLD] button. When the held data is no longer needed, release the data-hold operation by pressing the [HOLD] button again. When the meter is in the Data Hold mode, the [ΔREL], [MIN MAX], and [°C °F] buttons are disabled.

Relative Operation (TH-3 only)

Pressing the [ΔREL] button causes the meter to memorize the present reading. The difference between the new reading and the memorized data will be displayed. Press the [ΔREL] button again to exit the Relative mode.

MIN/MAX Operation

Pressing the [MIN MAX] button places the meter in the MIN/MAX mode. In this mode the maximum value and minimum value is kept in the memory simultaneously and updated with every new data reading. Pressing the [MIN MAX] button displays the MAX indicator and the Maximum value on the display. Pressing [MIN MAX] again will display the MIN indicator and the Minimum value on the display. Pressing [MIN MAX] again causes the MAX and MIN indicators to blink together. This means that these data have been updated in the memory and the reading is the present temperature and humidity. When the meter is in MIN/MAX mode, the [ΔREL] and [°C °F] buttons are disabled. To exit MIN/MAX mode, press and hold [MIN MAX] for two seconds.
Dew Point and Wet Bulb Temperature (THWD-3 only) Operation

The Meter displays ambient temperature when first turned on. To display dew point (DP) temperature, press $\text{DP WB}$ once. Press $\text{DP WB}$ again to switch to wet bulb (WB) temperature. Pressing $\text{DP WB}$ a third time returns the Meter to ambient temperature. The display indicates when dew point and wet bulb temperatures are selected.

Auto Power Off

By default, when the meter is powered on, it is in the auto power off mode. The meter will power itself off after 30 minutes if no key operation is performed. To disable the auto power off feature, press and hold the $\text{HOLD}$ button and then power on the meter. The auto power off symbol will disappear to indicate that auto power off is disabled.

Low Battery Condition

When the battery voltage is under proper operation requirement, the $\text{Eb}$ symbol displays on the LCD and the battery needs to be replaced.

Wet Bulb Temperature Readings (TH-3)

Occasionally the Wet Bulb temperature is required. Use the following procedure and your TH-3 to obtain the wet bulb temperature.

1. Determine RH% condition with the TH-3.
2. Determine temperature (dry-bulb) with the TH-3.
3. Locate dry bulb (DB) temperature line on the Psychrometric chart (vertical line across the bottom of the chart).
4. Locate relative humidity (RH) line on the chart (curved line across the chart).
5. Find the intersection of the DB and RH lines on the chart.
6. Draw a diagonal line, starting at your intersection point, until the Wet Bulb (WB) point is determined. (The wet bulb temperature line is at the outmost curve of the chart).

For example, locate the DB temperature of 78 °F on the Psychrometer chart. Locate the RH conditions of 50% RH on the chart. Draw a diagonal line up to the 65 °F WB point.
Humidity Sensor Reconditioning
If the unit is found to be out of specification for humidity, the sensor could be offset due to long exposure in a dry environment. This condition is typical of polymer type humidity sensors. The sensor will need to be rehydrated.

To rehydrate the sensor, keep it in a 20 °C to 30 °C environment that is >75% RH for at least 12 hours.

Recall Factory Calibration Data
1. Turn OFF the meter.
2. Press and hold “°C/°F” and “HOLD” button, then press 1 to power ON the meter. The display will blink for 3 seconds. While the display is blinking, press “MIN MAX” button to recall factory calibration data.
3. A long beep indicates the meter has reset to factory calibration data.
Limited Warranty and Limitation of Liability

Your Amprobe product will be free from defects in material and workmanship for 1 year from the date of purchase. This warranty does not cover fuses, disposable batteries or damage from accident, neglect, misuse, alteration, contamination, or abnormal conditions of operation or handling. Resellers are not authorized to extend any other warranty on Amprobe’s behalf. To obtain service during the warranty period, return the product with proof of purchase to an authorized Amprobe Test Tools Service Center or to an Amprobe dealer or distributor. See Repair Section for details. THIS WARRANTY IS YOUR ONLY REMEDY. ALL OTHER WARRANTIES - WHETHER EXPRESS, IMPLIED OR STATUTORY - INCLUDING IMPLIED WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY, ARE HEREBY DISCLAIMED. MANUFACTURER SHALL NOT BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES OR LOSSES, ARISING FROM ANY CAUSE OR THEORY. Since some states or countries do not allow the exclusion or limitation of an implied warranty or of incidental or consequential damages, this limitation of liability may not apply to you.

Repair

All test tools returned for warranty or non-warranty repair or for calibration should be accompanied by the following: your name, company’s name, address, telephone number, and proof of purchase. Additionally, please include a brief description of the problem or the service requested and include the test leads with the meter. Non-warranty repair or replacement charges should be remitted in the form of a check, a money order, credit card with expiration date, or a purchase order made payable to Amprobe® Test Tools.
In-Warranty Repairs and Replacement – All Countries

Please read the warranty statement and check your battery before requesting repair. During the warranty period any defective test tool can be returned to your Amprobe® Test Tools distributor for an exchange for the same or like product. Please check the “Where to Buy” section on www.amprobe.com for a list of distributors near you. Additionally, in the United States and Canada In-Warranty repair and replacement units can also be sent to a Amprobe® Test Tools Service Center (see address below).

Non-Warranty Repairs and Replacement – US and Canada

Non-warranty repairs in the United States and Canada should be sent to a Amprobe® Test Tools Service Center. Call Amprobe® Test Tools or inquire at your point of purchase for current repair and replacement rates.

In USA
Amprobe Test Tools
Everett, WA 98203
Tel: 877-AMPROBE (267-7623)

In Canada
Amprobe Test Tools
Mississauga, ON L4Z 1X9
Tel: 905-890-7600

Non-Warranty Repairs and Replacement – Europe

European non-warranty units can be replaced by your Amprobe® Test Tools distributor for a nominal charge. Please check the “Where to Buy” section on www.amprobe.com for a list of distributors near you.

European Correspondence Address*
Amprobe® Test Tools Europe
In den Engematten 14
79286 Glottertal, Germany
Tel.: +49 (0) 7684 8009 - 0

*(Correspondence only – no repair or replacement available from this address. European customers please contact your distributor.)
Specifications

Display: Dual display

Operating Conditions: 0°C to 40°C; <80% RH
Storage Conditions: -10°C to 60°C; <70% RH
Altitude: Up to 2000 meters, Indoor operation.
Sample Rate: 2.5 times per second
Battery: 9 V Battery, NEDA 1604 or JIS 006P or IEC6F22
Battery Life: 85-hours continuous; (with alkaline battery)
Dimension: 240x54x34 mm (9.5x2.1x1.3 in)
Weight: Approx.180g (6.4 oz.)
Accessories: Battery, instruction manual

TH-3, THWD-3
Humidity: 0% RH to 99% RH at 23°C
0°C to 55°C
32°F to 131°F

Range Accuracy
10% RH to 90% RH ± 3% RH
<10, >90 %RH ± 5% RH

Temperature Coefficient: 0.1x(specified accuracy)/ °C
(<23 °C or >23 °C)
Sensor hysteresis: +/-1 %RH
Resolution: 0.1%RH
Response Time (@ t90; in slowly moving air): 180 sec

TH-3, THWD-3
Temperature:
Range Accuracy
-20°C to 60°C ± 0.8 °C
-4°F to 140°F ± 1.6°F
THWD-3

Wet Bulb Temperature:

Range | Accuracy
--- | ---
0°C to 55°C | ± 0.8 °C
32°F to 131°F | ± 1.6°F

Dew Point Temperature:

Range | Accuracy
--- | ---
0°C to 55°C | ± 0.8 °C
32°F to 131°F | ± 1.6°F

Resolution: 0.1°C / 0.1°F

Response Time (@ t90; in slowly moving air): 10 sec
Visit amprobe.com for
• Catalog
• Application notes
• Product specifications
• User manuals

Amprobe®
amprobe.com
info@amprobe.com
Everett, WA 98203
Tel: 877-AMPROBE (267-7623)

Beha-Amprobe®
beha-amprobe.com
In den Engematten 14
79286 Glottertal, Germany
Tel.: +49 (0) 7684 8009 - 0
Acrylic block flowmeters are available in various sizes and ranges, with direct reading scales in both SAE and SI units for air and water. For other gases or liquids, special scales can be provided. If you use this meter with fluids other than air or water, please consult chemical compatibility data for possible effects on the meter. These meters are manufactured of durable acrylic and if properly installed and maintained, will provide long-term trouble-free operation.

UNPACKING
Precautions have been taken to prevent any damage from occurring during shipment. However, if the meter is received damaged, report it to the carrier immediately. Before installing, verify that you have the model and flow range required.

INSTALLATION
The Model 2510, 2520 & 2530 meters are supplied with 5/8” or 7/8” hex’s on the inlet and outlet fittings. When installing 1/8-27 MNPT or ¼-18 MNPT fittings into the meter, place the appropriate size wrench on the hex to prevent the inlet/outlet fitting from rotating. Torque only to 60 in-lbs. Failure to do so will cause the fitting to rotate, and may damage the meter body, causing leaks and/or meter failure.

The Model 2540 meters are supplied with round 1-11 ½ FNPT inlet and outlet fittings. When installing the meter, securely hold the meter’s fittings from rotating while connecting the flow lines.

Use pipe thread sealant or Teflon® tape to ease installation and provide a better seal.

These meters are supplied with #10-32 threaded inserts for mounting. When installing, use slotted screws and torque to a maximum of 35 in-lbs. Mounting dimensions are shown in Figures 1 & 2.

ACHIEVING ACCURATE FLOWRATES
To obtain an accurate flowrate, the float must be read at the position indicated on the meter. If the meter uses a ball float, the flowrate is determined by reading the center of the ball. Additionally, the flowmeter should be installed in a manner, which minimizes both external vibrations and internal flow variations. Special care should be taken so that the connections to the meter’s inlet and outlet fittings do not overly restrict the liquid or gas flow being metered. This could result in a reduced flow volume, preventing the meter from reaching its maximum flowrate. Furthermore, internal pressures could be affected, which can cause inaccurate flow readings. On start-up, slowly purge any fluid trapped in the meter.

CLEANING AND DISASSEMBLY
Occasional cleaning may be required if dirt appears in the flow tube or if float movement becomes restricted. To clean, remove the top plug and remove the float. Wash the tapered hole and top plug with a mild liquid detergent and soft brush. Rinse all parts with clean water and dry thoroughly with clean air or nitrogen. Do not use solvents to clean this meter as they will attack the acrylic and destroy the meter.

REASSEMBLY
Check to make sure that all parts are clean and dry. To lubricate the O-rings, apply a small amount of halocarbon grease prior to reassembly.

If applicable, reinstall the rod guide assembly into the flowmeter body. Make sure the rod guide is seated firmly in the body of the meter for a Standard Back meter or in the inlet fitting of the Inline meter. (For meters with valves, it will be necessary for the rod guide to pass through the slot in the valve tip.) To allow proper use of the valve, do not tighten the valve tip completely on the valve stem. Reinstall the top plug or the outlet fitting, making sure that the rod guide is properly aligned. Tighten top plug until it’s flush with top of acrylic body. Exceeding this may damage the meter body.

CAUTION
This flowmeter is designed for use with non-hazardous fluids at pressures up to 100 psi (690 kPa) and temperatures up to 150°F (65°C). Do not use hazardous fluids and do not exceed temperature or pressure limits. Use with hazardous fluids or exceeding the pressure and temperature limits may cause failure which could result in injury.
Table 1 Specifications - 2500 Series

<table>
<thead>
<tr>
<th></th>
<th>2510</th>
<th>2520</th>
<th>2530</th>
<th>2540</th>
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<tr>
<td><strong>Accuracy</strong></td>
<td>±5% full scale</td>
<td>±3% full scale</td>
<td>±2% full scale</td>
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<td><strong>Floats</strong></td>
<td>Black Glass, 316 Stainless Steel</td>
<td>Stainless Steel</td>
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<td><strong>Body</strong></td>
<td>Clear Acrylic</td>
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<td><strong>Seals</strong></td>
<td>Buna-N O-rings with Brass fittings; Viton® O-rings with 303 Stainless Steel fittings</td>
<td>Buna-N O-rings with Brass or PVC fittings; Viton O-rings with 303 Stainless Steel fittings</td>
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<td><strong>Pressure</strong></td>
<td>100 PSIG Max.</td>
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<td><strong>Temperature</strong></td>
<td>150°F/65°C Max.</td>
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<td>Brass, 303 Stainless Steel</td>
<td>PVC FNPT Pipe Connections (Std.)</td>
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<td><strong>Valves</strong></td>
<td>Brass or Stainless Steel</td>
<td>Integral Valve on &quot;V&quot; models</td>
<td>Integral Valve on &quot;V&quot; models for &quot;S and I&quot; models</td>
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<td>International Calibration Certificate (ICC); Pressure Equipment Directive (97/23/EC); RoHS</td>
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**Dimensions - Inches (MM)**

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<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>G-FNPT (2 Places)</th>
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<tr>
<td>2510</td>
<td>4&quot; (102)</td>
<td>3&quot; (76.2)</td>
<td>1&quot;</td>
<td>1-5/8&quot; (41.3)</td>
<td>1-3/16&quot; (30.2)</td>
<td>1-1/8&quot; (28.6)</td>
<td>1/8&quot; FNPT</td>
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<tr>
<td>2520</td>
<td>6-1/2&quot; (165)</td>
<td>5-1/2&quot; (140)</td>
<td>1-3/8&quot; (34.9)</td>
<td>3-1/2&quot; (88.9)</td>
<td>1-1/2&quot; (38.10)</td>
<td>1-1/8&quot; (28.6)</td>
<td>1/8&quot; FNPT</td>
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<tr>
<td>2530*</td>
<td>6-5/8&quot; (168)</td>
<td>5-1/2&quot; (140)</td>
<td>1-1/8&quot; (28.6)</td>
<td>3-1/2&quot; (88.9)</td>
<td>1-1/2&quot; (38.1)</td>
<td>1-3/8&quot; (34.9)</td>
<td>1/4&quot; FNPT</td>
<td></td>
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</table>

* Does not include 1/8" back plate

Figure 1 Dimensions - Model 2510, 2520 & 2530

TRADEMARKS
Brooks ........................................................... Brooks Instrument, LLC
All other trademarks are the property of their respective owners.

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Brooks Instrument
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19440-0903 USA
Toll-Free (USA): 888-554-FLOW
T: 215-362-3500
F: 215-362-3745
BrooksAbi@BrooksInstrument.com

A list of all Brooks Instrument locations and contact details can be found at www.BrooksInstrument.com

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Series 477A Handheld Digital Manometer
Specifications - Installation and Operation Instructions

Series 477A Digital Manometers are versatile, hand-held, battery operated manometers available in several basic ranges from 0-20 in. w.c. up to 100 psi. All models measure either positive, negative or differential pressures with ±0.10% of full scale accuracy. You can select from up to seven common English and metric pressure units so conversions are not necessary. A memory function allows storage of up to 40 readings for later recall and a backlight provides auxiliary lighting for hard-to-see locations. Also standard are a hold feature plus both visual and audible over-pressure alarms.

**SPECIFICATIONS**

- **Service:** Air and compatible gases.
- **Wetted Parts:** Consult factory.
- **Accuracy:** ±0.10% of full scale from 60 to 78°F (15.6 to 25.6°C); ±1% of full scale from 32 to 60 and 78 to 104°F (0 to 15.6 and 25.6 to 40°C).
- **Pressure Hysteresis:** ±0.1% of full scale.
- **Pressure Limits:** See chart.
- **Temperature Limits:** 32 to 104°F (0 to 40°C).
- **Storage Temperature Limits:** -4 to 176°F (-20 to 80°C).
- **Display:** 4-digit LCD (.425” H x .234” W digits).
- **Resolution:** See chart.
- **Power Requirements:** 9 volt alkaline battery. Battery included but not connected.
- **Weight:** 10.2 oz. (289 g).
- **Connections:** Two barbed connections for use with 1/8” (3.18 mm) or 3/16” (4.76 mm) I.D. tubing for 477A-1, 477A-2, 477A-3, 477A-4 and 477A-5 only. Two compression fittings for use with 1/8” (3.18 mm) I.D. x 1/4” (6.35 mm) O.D. tubing for 477A-6 and 477A-7 only.

<table>
<thead>
<tr>
<th>Model Number</th>
<th>English Range</th>
<th>Metric Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>477A-1</td>
<td>0-20.00 in. w.c.</td>
<td>0-4.982 kPa</td>
</tr>
<tr>
<td>477A-2</td>
<td>0-40.00 in. w.c.</td>
<td>0-9.96 kPa</td>
</tr>
<tr>
<td>477A-3</td>
<td>0-200.0 in. w.c.</td>
<td>0-49.82 kPa</td>
</tr>
<tr>
<td>477A-4</td>
<td>0-10.00 psi</td>
<td>0-68.95 kPa</td>
</tr>
<tr>
<td>477A-5</td>
<td>0-30.00 psi</td>
<td>0-206.9 kPa</td>
</tr>
<tr>
<td>477A-6</td>
<td>0-50.00 psi</td>
<td>0-344.8 kPa</td>
</tr>
<tr>
<td>477A-7</td>
<td>0-100.0 psi</td>
<td>0-689.5 kPa</td>
</tr>
</tbody>
</table>

**Maximum Pressure**

- 477A-1: 3 psi (0.21 bar)
- 477A-2: 3 psi (0.21 bar)
- 477A-3: 15 psi (1.03 bar)
- 477A-4: 30 psi (2.07 bar)
- 477A-5: 60 psi (4.13 bar)
- 477A-6: 100 psi (6.89 bar)
- 477A-7: 200 psi (13.78 bar)

**Available Pressure Units:**

477A-1 & 477A-2: psi, in. w.c., mm w.c., in. Hg, mm Hg, Pa, kPa, bar, mbar

477A-3 & 477A-4: psi, in. w.c., mm w.c., in. Hg, mm Hg, kPa, bar, mbar

477A-5, 477A-6 & 477A-7: psi, in. w.c., in. Hg, mm Hg, kPa, bar, mbar
INSTRUCTIONS

Battery Installation
The unit is shipped with a separate 9 volt alkaline battery which must be installed before operation. Remove the two screws holding the bottom endcap in place and remove the endcap. Connect the battery to the enclosed battery clip observing correct polarity. Be careful not to trap wires between the battery, case or foam pads which retain the battery. This could make it difficult to install the battery or remove it later for replacement. Be sure the rubber gasket is properly seated in the gasket channel of the endcap and replace endcap. Note that the endcap will only fit one way because the holes are slightly off-center. Place the “Z” shaped wrist strap clip in one of the screw recesses and replace the screws. Do not overtighten the screws. Attach wrist strap to clip.

When battery replacement becomes necessary, use only a 9 volt alkaline type such as a Duracell® MN1604, Eveready® 522 or equivalent. Zinc-carbon types, often labeled Heavy-duty are not recommended because of the increased potential for leakage. Alkaline batteries are also a better value because they last up to three times longer in this device.

On-Off Operation
The on-off control is a toggle function. Press and release the ON/OFF key once to turn unit on; again to turn it off. If the manometer is left on with no activity for approximately 20 minutes, unit will turn itself off to conserve the battery.

Display Backlight
The Model 477A includes a display backlight to allow use in the dark or in poor lighting conditions. Manometer must be switched off before this feature can be activated. Next, press and hold the ON/OFF key down. After about 1 second the backlight will come on and remain lighted for approximately 2 minutes after which it will turn itself off to conserve battery life.

Zeroing Pressure Reading
Potential inaccuracy due to temperature effects can be minimized by re-zeroing immediately before use. To zero the display, vent both ports to atmosphere so no pressure is applied to either port. Press the ZERO/STORE key and - - - - will be momentarily displayed as zeroing occurs. Zeroing is not possible when the memory mode is in use. It must be done before selecting that function.

If the unit is accidently zeroed with pressure applied to one of the ports, the pressure reading might display incorrectly. To correct, vent the pressure ports to atmosphere and press the ZERO/STORE key to zero the unit.

Pressure Connections
To measure single positive pressure, connect tubing to port marked + and vent opposite port to atmosphere. To measure differential positive pressure, connect higher positive pressure to port marked + and lower positive pressure to port marked -. Manometer will indicate the difference between the two.

Selecting Pressure Units
Up to seven pressure units are available. The display will indicate the current selection. To change to different units, use the UNITS/LOC key. Each touch will cause an advance to the next choice. The selected units will remain in memory even when power is shut off. This way, your preference will always be displayed after the initial selection.
Display Hold
There may be situations where you want to temporarily retain a reading. The Model 477A includes a Display Hold feature which freezes the current reading and holds it in the display until cleared. To activate this operation, momentarily press the HOLD/MEMORY key when the pressure you want to save is displayed. A HOLD indicator will appear in the display to indicate that the reading shown is frozen. To return to normal operation, press the HOLD/MEMORY key again. The HOLD indicator will disappear and the current pressure will again be shown.

Memory Function
A memory function is included in the Model 477A that allows you to store up to 40 pressure readings for later review or recording. This feature is especially valuable for making a traverse of duct velocity pressures with a Pitot tube or for multipoint pressure measurements. The readings are stored in non-volatile memory so they will be retained even if the unit is shut off or the battery is removed.

Storing Pressure Readings
To store a reading, press and hold the HOLD/MEMORY until ST01 is displayed then release the key. Next, press ZERO/STORE key to save current reading to ST01 memory location. A beep will sound indicating that the reading has been saved. As each reading is saved, the memory location display will advance to the next number. To resume pressure measurement, press the HOLD/MEMORY key again. Note that in the memory mode, the display zero function is not available. To zero the display, you must first exit the memory mode and then press the ZERO/STORE key.

Viewing Stored Readings - Selecting a Location
To view the contents of memory, press and hold the HOLD/MEMORY until RD01 is displayed then release the key. Next, press UNITS/LOC to view other memory location. To resume pressure measurement, press the HOLD/MEMORY key again.

Clearing Memory
To clear the contents of memory, press and hold the HOLD/MEMORY until CLR is displayed then release the key. Next, press ZERO/STORE key to clear all previously stored readings. During this operation - - - - will be displayed. Once memory is cleared, the current pressure will be displayed.

Exiting Memory Mode
To exit the memory mode press the HOLD/MEMORY key again and the unit will return to normal operation.
**Dampening Function**

The dampening feature allows the user to enter a dampening number from 1 to 16 (default value = 2). Entering a larger number increases the amount of readings that are averaged for each display update.

In order to access the dampening feature, follow the instructions below:

1. Press and hold the HOLD/MEMORY button. The upper right portion of the LCD scrolls through a menu selection (HOLD, ST01, RD01, CLR, and DAMP). When “DAMP” is shown, release the HOLD/MEMORY button. This selects the dampening feature.

2. Once “DAMP” is selected, a number is shown in the upper right portion of the LCD, along with the current pressure reading. This number is the dampening number. Adjust the number up by pressing the ZERO/STORE button or down by pressing the UNITS/LOC button. The LCD update rate slows as the number increases from 1 to 16. Therefore, for best results, choose the smallest number that provides a stable pressure reading.

Once the pressure reading is stable, press and release the HOLD/MEMORY button to store the dampening value.

**Overpressure Alarm**

A visual indicator and audible alarm are provided to alert the operator that pressure has exceeded the operating range of the unit. Exceeding the range will not damage it or affect calibration as long as the maximum rated pressure is not exceeded. Do not exceed the maximum rated pressure of the manometer. Doing so will cause permanent damage to the sensor, may rupture the housing and/or cause injury. The maximum pressure is shown on the rear label and on page 1 of these instructions.

**Low Battery Indicator**

A weak battery can cause improper operation or inaccurate measurements. A low battery indicator is provided on the display to show when the battery needs replacement. Although the unit might appear to function and indicate properly, the accuracy of readings cannot be guaranteed when the LOW BAT indicator is illuminated. Replace the battery with a fresh one. Do not leave an exhausted battery in the unit due to potential leakage.

**MAINTENANCE**

The Series 477A handheld digital manometers are not field repairable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.

*Duracell® is a registered trademark of The Gillette Company*

*Everready® is a registered trademark of The Eveready Battery Company, Inc.*
<table>
<thead>
<tr>
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<th>C-DLR 60</th>
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**Data**

**Elmo Rietschle**

A Gardner Denver Product

**C-DLR**

- C-DLR 60
- C-DLR 100
- C-DLR 150

**Zephyr**

**Dimensions** (inches)

- **Suction**
- **Succión**
- **Pressure connection**
- ** Conexion presión**
- **Safety valve**
- **Válvula seguridad**
- **Cooling air entry**
- **Entrada aire refrigerante**
- **Cooling air exit**
- **Salida aire refrigerante**
- **Data plate**
- **Placa fecha**
- **Rotation arrow**
- **Dirección de rotación**
- **Inlet silencer**
- **Silenciador entrada**

**Aspiration**

- **Raccord surpression**
- **Clapet de sécurité**
- **Entrée air refroidissement**
- **Sortie air refroidissement**
- **Etiquette caractéristique**
- **Flèche sens rotation**
- **Silencieux d'aspiration**

**Sucção**

- **Conexão da pressão**
- **Válvula de segurança**
- **Entrada do ar refrigerante**
- **Saída do ar refrigerante**
- **Placa de data**
- **Direção da rotação**

**Silenciador de entrada**

---

**Gardner Denver**

Hanover Inc.

2222 Parkway Drive

HANOVER, MD 21076

USA

Phone: +1 410 / 712 4100

Fax: +1 410 / 712 4148

e-mail: sales.hanover@gardnerdenver.com

www.gd-elmorietschle.com

**DA 881/1**

1.2.2006
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| ZMS / ZAD | # | # |        |

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Curves and tables refer to compressor at normal operating temperature. Las curvas y las tablas se refieren al compresor a la temperatura normal de operación. Les courbes et tableaux sont établis, compresseur à température de fonctionnement. As curvas e tabelas referem-se ao compressor a temperatura normal de operação.

Technical information is subject to change without notice. La información técnica está sujeta a cambios sin previo aviso. Sous réserve de modification technique. A información técnica está sujeta a mudança sem aviso prévio.

The listed values for a, c, w and full load amperage may vary because of different motor manufacturers. Los valores listados para a, c, w y para el amperaje de carga completa pueden variar para distintos fabricantes de motores. Les valeurs listées pour a, c, w et pour l'amperage au régime maximum peuvent varier pour différents fabricants de moteurs. Como variam os fabricantes de motores, podem haver variações dos valores indicados para a, c, w e para uma amperagem de carga total.

* Capacity refers to free air at 1 standard atmosphere and 20° C (68° F). La capacidad se refiere al aire libre a 1 atmósfera estándar de presión y a 20° C (68° F) de temperatura. Le débit est mesuré à l’atmosphère de 1 bar (atm) à 20° C (68° F). / A capacidad se refiere ao ar livre a uma atmosfera padrão 1 a 20° C (68° F).

Curves and tables refer to compressor at normal operating temperature. Las curvas y las tablas se refieren al compresor a la temperatura normal de operación. Les courbes et tableaux sont établis, compresseur à température de fonctionnement. As curvas e tabelas referem-se ao compressor a temperatura normal de operação.

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* on request. # sur demande. # a pedido.
7 REFERENCE

7.1 Specifications

7.1.1 System Outline

<table>
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<th>Model</th>
<th>MEXA-564L</th>
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<td>ISO3930/OIML R99(2006) Class 0*1</td>
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<td>Certified by the Japanese Ministry of Transport</td>
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</table>

Application

- Exhaust gases from gasoline vehicle (two-wheel or four-wheel vehicle), LPG vehicle (four-wheel vehicle)

Principle

- CO, HC, CO₂: non-dispersive infrared (NDIR)
- Air-to-fuel ratio (AFR), Excess air ratio (λ, lambda): carbon balance method, or Breitishneider method (with O₂ measurement)*2

Measured/displayed components

- Measured components (standard):
  - CO: 0.00 %vol to 10.00 %vol
  - HC: 0 ppmvol to 10000 ppmvol, or 0 ppmvol to 20000 ppmvol*3 (as hexane equivalent value)
  - CO₂: 0.00 %vol to 20.00 %vol
  - AFR: 10.0 to 30.0
  - LAMBDA: 0.000 to 9.999

- External input components (optional):
  - O₂: 0.00 %vol to 25.00 %vol
  - NO: 0 ppmvol to 5000 ppmvol
  - Engine speed (RPM): 0 rpm to 9990 rpm (Guaranteed range for linearity is 200 rpm to 6000 rpm)
  - Oil temperature (TEMP): 0°C to 150°C

- Display resolution:
  - CO: 0.01 %vol
  - HC*2: 1 ppmvol (within the range of 0 ppmvol to 2000 ppmvol), 10 ppmvol (within the range of 2000 ppmvol to 10000 ppmvol)
  - CO₂: 0.02 %vol
  - AFR: 0.1
  - LAMBDA: 0.001
  - O₂: 0.01 %vol
  - NO: 1 ppmvol
  - RPM: 10 rpm*4
  - TEMP: 1°C

Monitor display

- LCD (black and white, 320 x 240 dot)

Input/output

- Digital input/output: RS-232C (standard), RS-485 (optional)*5
- Printer: RS-232C

*1: The following functions required by the ISO 3930/OIML R99 standard are intentionally not equipped considering the practical operation by users.
- The instrument is not able to perform the measurement if the value at a leak check and/or HC hang-up test exceeds the limit value.
- The instrument stops the measurement when the pressure in sample gas line is too low (filter alarm).

When such error or alarm is displayed, refer to "6.4 Trouble Shooting" (page 50) and start measurements after solving problems.

*2: Air-to-fuel ratio (AFR) and excess air ratio (λ) are calculated by the carbon balance method in standard configuration. In case that an optional O₂ sensor is connected, the Breitshneider equation is also available. Specify the equation to be used when you order.

*3: For optional range for HC, 20000 ppmvol, display resolution is 2 ppmvol within the range of 0 ppm to 4000 ppm, and 20 ppmvol within the range of 4000 ppmvol to 20000 ppmvol.

*4: Display resolution of RPM is "1 rpm" as for the units which are delivered for India.

*5: Contact HORIBA for quotation on RS-485 connection (optional). For connection an external PC with a communication software which supports USB port, use a RS232C/USB converter on the market.

7.1.2 Configurations/Conditions

- Connection of sample gas: Dedicated flexible probe is attached
- Sample gas flow rate: Approx. 4 L/min
- Sample gas pressure: From 0.0 kPa to 1.0 kPa
- Calibration gas: Dedicated cylinder
  - Mixed gas of CO, C₂H₄ and CO₂
  - NO (for the instrument with NO analyzer (optional))
- Environment for operation:
  - Temperature: 0°C to 45°C
  - Humidity: Below 90% as relative humidity
  - Ambient pressure: 80 kPa to 106 kPa (~300 m to 2100 m as altitude)
- Environment for storage:
  - Temperature: -30°C to 60°C
  - Humidity: Below 90% as relative humidity, without water condensation
- Power supply*6: 100 V to 240 V AC, 50 Hz to 60 Hz, single phase
- Power capacity: Approx. 90 W at stable state
- Dimensions: 280 (W) x 357 (D) x 157 (H) mm (without optional units)
- Mass: Approx. 4 kg (without optional units)

*1: For using the analyzer with a DC power source, prepare a DC/AC inverter on the market.
### 7.1.3 Performance

**Response speed**
- **CO, HC, CO₂:** Within 15 s, as Td + Tbg, when switching zero gas and span gas
- **O₂:** Within 15 s, as Td + Tbg, when switching air to zero gas
- **NO:** Within 40 s, as Td + Tbg, when switching zero gas and span gas

**Linearity**
- **CO:** Within 0.03 vol%, or within 3% of reading (whichever is larger)
- **HC:** Within 10 ppmv, or within 5% of reading (whichever is larger)
- **CO₂ (0.00 %vol to 8.00 %vol):** Within 0.3 %vol, or within 5% of reading (whichever is larger)
  - (8.01 %vol to 15.00 %vol): Within 0.4 %vol
  - (15.01 %vol to 16.00 %vol): Within 0.6 %vol
  - (16.01 %vol to 20.00 %vol): Within 4% of reading
- **O₂:** Within 0.1 %vol, or within 3% of reading (whichever is larger)
- **NO (0 ppmv to 4000 ppmv):** Within 25 ppmv, or within 4% of reading (whichever is larger)
  - (4001 ppmv to 5000 ppmv): Within 8% of reading
- **RPM (200 rpm to 6000 rpm):** Within ±10 rpm
- **TEMP:** Within ±2°C

**Repeatability**
- **CO:** Within 0.01 vol%, or within 1.7% of reading (whichever is larger)
- **HC:** Within 3.3 ppmv, or within 1.7% of reading (whichever is larger)
- **CO₂:** Within 0.17 %vol, or within 1.7% of reading (whichever is larger)

**Warm-up time**
- 5 minutes

**Warm-up condition**
- **CO:** Within 0.03 vol%, or within 5% of reading (whichever is larger)
- **HC:** Within 10 ppmv, or within 5% of reading (whichever is larger)
- **CO₂:** Within 0.4 vol%

**Drift**
- **CO:** Within 0.03 vol%, or within 5% of reading (whichever is larger)
- **HC:** Within 10 ppmv, or within 5% of reading (whichever is larger)
- **CO₂:** Within 0.4 vol%

**Test gas**
- **CO:** 6 vol%
- **CO₂:** 16 vol%
- **H₂O:** 20°C ±2°C saturation

**Interference effect**
- **CO:** Within 0.02 vol%
- **HC:** Within 0.02 vol%
- **CO₂:** 0.25 vol%

**Power supply voltage fluctuation effect**
- **CO:** Within 0.02 vol%, or within 2.5% of reading (whichever is larger)
- **HC:** Within 5 ppmv, or within 2.5% of reading (whichever is larger)
- **CO₂:** Within 0.25 %vol, or within 2.5% of reading (whichever is larger)

**Propane equivalent factor of HC readings**
- Between 0.490 and 0.540

---

1. Span gas for the performance test shall be approx. 0.5 %vol for CO, 200 ppmv for CO₂, and 14 %vol for O₂.
2. When calibration gases are switched at sample inlet with the optional probe attached.
3. Linearity of gas component is defined as the maximum reading error when below standard gases are used after zero/span calibration. Ambient temperature for linearity test shall be within 20°C ±2°C for gas components, and 25°C ±2°C for "RPM" and "TEMP". Performance of external input components (O₂, NO, RPM and TEMP) are guaranteed only for the sensors specified below.
4. CO: 0.5 %vol, 1 %vol, 3.5 %vol, 5 %vol
   - CO₂: 200 ppmv, 600 ppmv, 2000 ppmv
   - O₂: 0.5 %vol, 10 %vol, 20.9 %vol
   - NO: 200 ppmv, 800 ppmv, 4500 ppmv
5. Repeatability is described as the standard deviation of values of 20 repeated measurements.
6. Maximum reading error directly after completing the warm-up, then two minutes, five minutes and 15 minutes.
7. Maximum reading error for zero/span gas measurement done at 30-minute intervals from first 30 minutes after warm-up completion to next four hours.
8. Maximum reading affect where power fluctuations within the 85% to 110% of specified range (100 V to 240 V AC).

### 7.1.4 Options

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>O₂ sensor</strong></td>
<td>Electrochemical sensor, Teledyne, model: R22-A</td>
</tr>
<tr>
<td><strong>NO sensor</strong></td>
<td>Electrochemical sensor, Cify Technology, model: N1X</td>
</tr>
<tr>
<td>Thermometer</td>
<td>Thermometer, tachometer, Capelecs,</td>
</tr>
<tr>
<td>tachometer</td>
<td>● Model: CAP895</td>
</tr>
<tr>
<td></td>
<td>● Connection: to be connected by RS-232C</td>
</tr>
<tr>
<td></td>
<td>● Cable length: 0.5/m/357/10 m (to be specified for order)</td>
</tr>
<tr>
<td>Tachometer</td>
<td>Clamp sensor, Tecnost,</td>
</tr>
<tr>
<td></td>
<td>● Model: SL0903</td>
</tr>
<tr>
<td></td>
<td>● Cable length: 5.0 m ±0.2 m</td>
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<tr>
<td>Oil temperature sensor</td>
<td>Tecnost,</td>
</tr>
<tr>
<td></td>
<td>● Model: SL51080 888</td>
</tr>
<tr>
<td></td>
<td>● Cable length: 5.0 m ±0.2 m</td>
</tr>
<tr>
<td>Printer</td>
<td>Serial printer,</td>
</tr>
<tr>
<td></td>
<td>Model: CBM-9101-24RF-100A (for 100 V AC)</td>
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<tr>
<td></td>
<td>CBM-9101-24RF-120A (for 120 V AC)</td>
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<tr>
<td></td>
<td>CBM-9101-24RF-230A (for 230 V AC)</td>
</tr>
<tr>
<td>Printer cable</td>
<td>RS-232C cable, 1.5 m</td>
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<tr>
<td>External communication software</td>
<td>To be installed in an external PC with Windows XP/Visia-OS and a RS-232C serial port</td>
</tr>
<tr>
<td>Input/output cable</td>
<td>RS-232C cable; 2.5 m, 5 m, 10 m</td>
</tr>
<tr>
<td>Analog output board</td>
<td>0 V to 1 V</td>
</tr>
<tr>
<td>Optional probe</td>
<td>6 mm O.D./4 mm I.D., copper pipe</td>
</tr>
<tr>
<td>Drain separator</td>
<td>Separately attached</td>
</tr>
</tbody>
</table>
7.2 Lambda Formula with O₂ Measurement

For lambda calculation, based upon measurements of CO, CO₂, HC and O₂, the following formula is applied:

$$\lambda = \frac{\frac{[\text{CO}_2]}{2} \cdot [\text{O}_2] + \left( \frac{H_m \times \frac{3.5}{\text{[CO]}}} {4} + \frac{D_m}{2} \right) \cdot [\text{CO}] + [\text{O}_2]} {\left[ \frac{H_m \times \frac{3.5}{[\text{CO]}}}{4} \right] \cdot [\text{CO}] + [\text{O}_2]}$$

Where

- [] is the concentration in %vol, for HC only in ppmvol.
- $K_1$ is the conversion factor for HC if expressed in ppmvol n-hexane ($C_6H_{14}$) equivalent. Its value in this formula is $6 \times 10^{-3}$.
- $H_{CV}$ is the atomic ratio of hydrogen to carbon in the fuel.
- $O_{CV}$ is the atomic ratio of oxygen to carbon in the fuel.
1 HP Separate Drive Vacuum Pump; Inlet Size: 3/4" NPT, Outlet Size: 3/4" NPT

Web Price:
$1,057.00 / each

Expected to arrive Wed, Jun 20.
Ship To 81101 (Change)

Shipping Weight: 57.7 lbs.

Country of Origin: USA

Product Details
Ideal for general continuous-duty vacuum and low-pressure applications. Included coupling and coupling guard allow you to mount pump directly to 56C frame motors.

- Permanently lubricated and sealed bearings
- Self-adjusting, self-lubricating vanes

Note: When used for pond aeration, include the appropriate check valve in discharge line to prevent water from entering pump in case of power failure.

Technical Specs

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP</td>
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<td>1</td>
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<tr>
<td>Compressor Type</td>
<td>Rotary Vane</td>
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<tr>
<td>S</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Inlet Size</td>
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<tr>
<td>Outlet Size</td>
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<td>Free Air CFM @ 0 PSI</td>
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<td>Free Air CFM @ 10 PSI</td>
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<td>Overall Width</td>
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<td>Overall Height</td>
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<td>Design</td>
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<tr>
<td>Motor Mounting</td>
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<tr>
<td>Standards</td>
<td>CSA</td>
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</tr>
<tr>
<td>Includes</td>
<td>Coupling and Coupling Guard</td>
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</table>
1/8 HP Diaphragm Compressor/Vacuum Pump

PRODUCT DETAILS
Permanently lubricated, virtually maintenance-free unit offers the versatility of reversible 1/8" and 1/4" inlet and outlet ports. Quiet operation and designed for applications requiring moderate pressure and continuous duty. Cilless for low maintenance.

TECHNICAL SPECS

<table>
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<tr>
<th>Item</th>
<th>Compressor/Vacuum Pump</th>
<th>Max. Vacuum</th>
<th>Max. PSI Cont./Int.</th>
<th>Free Air CFM @ 0 PSI</th>
<th>Free Air CFM @ 20 Vacuum</th>
<th>Overall Length</th>
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<tr>
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<td>25.5&quot; Hg</td>
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<td>Inlet Size</td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Outlet Size</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
PORTABLE METHANE DETECTOR

INSTRUCTION MANUAL
READ AND UNDERSTAND INSTRUCTIONS BEFORE USE
**Warnings:**

• To prevent ignition of flammable or combustible atmospheres disconnect power before servicing.

• Remove and charge battery pack in an area known to be free of combustible gases.

• Use only Sensit Technologies battery pack.

• Service may only be performed by factory authorized service technicians

• Not for use in environments greater than 21% oxygen.

**Safety Precautions:**

• Read and understand instructions prior to use.

• Always start the PMD in an area known to be gas free.

• Tampering with this product may void the warranty.

• Use only Sensit Technologies approved parts and accessories.

• Never use an instrument known to be damaged, operating unusually, or out of calibration.

**For further information contact Sensit Technologies.**

Sensit Technologies  
851 Transport Drive  
Valparaiso, Indiana  
46383  
USA

Tel: 219/465-2700  
Fax: 219/465-2701

Email: info@gasleaksensors.com  
Web: www.gasleaksensors.com
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<tr>
<td>Warranty</td>
<td>20</td>
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</tbody>
</table>
General Description

The Sensit® PMD, referred to as the “PMD”, is designed to detect methane gas from 1ppm up to 100% volume. The PMD may be used for walking surveys and vehicle surveys (when properly installed) for underground natural gas piping systems. Other applications include landfill monitoring and checking piping systems where other interfering gases may provide inaccurate readings.

The PMD senses gas using Infrared (IR) Absorption Spectroscopy in combination with an electronic narrow band pass filter. This technology utilizes an infrared light source with an output that is changed when certain gases absorb the light output. The filter only allows specific light wavelengths to be monitored and measured. The concentration of gas is proportional to the amount of specific IR light absorbed and is displayed in PPM, %LEL and/or %Vol.

The PMD has a large display indicating concentration and other instrument functions such as battery charge and performance. An internal pump provides rapid sampling into the detection chamber. Audible and visual alarms indicate when preset alarms are exceeded. Bluetooth data transmission provides communication of real time and stored data. Optional GPS and Data Logging allow for further recording of time, date and location data.
## Accessories

### Standard Accessories

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telescopic Survey Probe</td>
<td>883-00029</td>
</tr>
<tr>
<td>Shoulder (Carrying) Strap</td>
<td>360-00238</td>
</tr>
<tr>
<td>Lithium Rechargeable Battery Pack</td>
<td>871-00017</td>
</tr>
<tr>
<td>Universal Wall Charger</td>
<td>871-00025</td>
</tr>
<tr>
<td>Battery Door Removal Tool</td>
<td>360-00249</td>
</tr>
<tr>
<td>Instruction Manual</td>
<td>750-00045</td>
</tr>
<tr>
<td>Hydrophobic Filter Ring Assembly (10 Pack)</td>
<td>873-00033</td>
</tr>
<tr>
<td>Survey Probe Filter (Blue) (1 Filter)</td>
<td>360-00064</td>
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</table>

### Optional Accessories

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiberglass Bar Hole Probe</td>
<td>883-00019</td>
</tr>
<tr>
<td>Brass Bar Hole Probe</td>
<td>883-00018</td>
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<tr>
<td>HD Fiberglass Bar Hole Probe</td>
<td>883-00021</td>
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<tr>
<td>PMD Manual Calibration Kit</td>
<td>881-00070</td>
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<tr>
<td>Bump Gas Cylinder (50ppm CH4)</td>
<td>315-03000 4</td>
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<tr>
<td>Delux Hard Carrying Case</td>
<td>872-00010</td>
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<tr>
<td>Compact Carrying Case</td>
<td>872-00013</td>
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<tr>
<td>Shipping Box and Foam</td>
<td>872-00017</td>
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<tr>
<td>Hot Swap Vehicle Battery</td>
<td>871-00030</td>
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<tr>
<td>Removable Memory Card</td>
<td>360-00243</td>
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<tr>
<td>PMD Harness</td>
<td>870-00046</td>
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### Replacement Parts

<table>
<thead>
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<th>Item Description</th>
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<tr>
<td>Shoulder (Carrying) Strap</td>
<td>360-00238</td>
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<tr>
<td>Filter Cap Assembly “O” Rings</td>
<td>870-00034</td>
</tr>
<tr>
<td>Survey Probe Filter (Blue) (1 Filter)</td>
<td>360-00064</td>
</tr>
</tbody>
</table>
Product Specifications

Operational Specifications

Temperature: -4 to 122F
Duty Cycle: ~7 hours
Response time: T50 < 3 seconds
Alarms:
Audible - 95db @ 15 inches
Visual – Red backlight on display
Visual – Display info
Visual – Failure indicators
Settings – PPM and LEL
Power:
Lithium Ion Rechargeable battery pack
Optional Vehicle power adapter
Pump Flow: 1 lpm
Detection Range: 0-5000ppm
  10–100% LEL
  5-100% V/V

Physical Specifications

Size: 11" x 4.5" x 6.5" (Approximate)
Weight: 6.1Lbs
Construction: Cast Aluminum/ABS Plastic

Sensor Specifications

IR Sensor:
  Wavelength – 3.4m
  Detection Range 1ppm – 100% v/v
  Warm up < 10 min
  Calibration required - 3 months

Product Features

- The PMD is constructed of durable ABS plastic
- The housing is designed to meet IP54 protection
- The PMD is designed to meet Cat 3 Intrinsic Safety requirements
- Battery pack is designed for easy field replacement
- Field or Smart Cal calibration is easily performed
- External filters are inexpensive easy to change
- The LCD display is easy to read
- The PMD uses a simple “Sensit Style” user interface
- Communication with other devices is easy with Bluetooth interface
- Real time GPS is optional
- Real time Data logging with removable storage option
Electronic Features

User Interface

The user interface includes the following features:
• Three button operation
• LED Status indicators
• Sounder
• Photo cell (automatic backlighting)
• IR communication port
• LCD

Button Operation

The Sensit PMD is operated with the use of three buttons below the display.

They are labeled A, B, C.

The “A” button:
• activates/deactivates the instrument
• mutes the audible alarms
• access Smart-Cal communication

The “B” button:
• Accesses the quick menu and user menu
• Digitally adjusts the TICK sound for leak locating

The “C” button:
• Saves displayed readings to the internal memory
• Performs a manual zero.
Display Features

The display provides all information including:
- Gas concentration in PPM, LEL AND %Vol
- Battery voltage status
- Pump Status
- GPS activation and coordinates
- Bluetooth operation
- Data logging operation
- Warning indication
- Tick operation

Icons on the display indicate the status of various functions.

- Flow OK
- Flow blocked

- Alarm not muted
- PPM alarm muted

- %LEL alarm muted
- %GAS alarm muted

- Warning/trouble/failure symbol

- Bluetooth On and Connected
- Bluetooth on but not connected

- Tick ON

- Data logging on – flash once for data save
- Data Saved – flash once for manual data save

- GPS Connected
- GPS enabled-not connected
Alarm settings

There are 3 adjustable alarm settings.

1. PPM
   a. Default: 10ppm
   b. Low Limit: 0
   c. High limit = 500
   d. Disable PPM alarm: Set the PPM alarm to 0
   e. Alarm: Audible, LED, Red backlight if unit in dark

2. %LEL
   a. Default: 50% LEL
   b. Low Limit: 10% LEL
   c. High limit = 90% LEL (If no autorange to %gas)
   d. Disable LEL alarm: Can not disable this alarm (mute only)
   e. Alarm: Audible, LED, Red backlight if unit in dark

3. %GAS
   a. Default 17% Vol
   b. Low Limit: 5% Vol
   c. High Limit: 50% Vol
   d. Disable %GAS alarm: Can not disable this alarm
   c. Alarm: LED, Red backlight if unit in dark

Adjustment of the ppm alarm is covered in the User Menu portion of this manual.

Housing Features

Battery Pack

The battery pack is located on the back side of the instrument housing. The batteries are Lithium Ion rechargeable. The batteries are only available from Sensit Technologies.

To remove the battery pack turn the retaining screws ¼ turn. Pull the bottom of the pack away from the main housing. Recharging of the battery pack requires removal from the main housing.

To replace slide the top tabs of the battery pack into the retainers at the top of the main housing. Push the bottom into place and turn and lock the retaining screws.
The battery pack has LED’s to indicate charge status. Charging should only be performed in an area known to be free of combustible gases.

Gas Inlet and Outlet

Located on the front of the main housing is the gas inlet and outlet. Both are fitted with luer-style connections for easy connection to probe accessories.

The center connection is the gas inlet. To the right is the outlet. Do not block gas outlet.

Shoulder Strap attachment

“D” rings are located on each side of the main housing for shoulder strap attachment. Clips on the strap will attach securely.
Hydrophobic Filter Assembly

**WARNING:** Do not operate without proper filter. Damage may occur to the pump and other internal parts. Only change filter with pump or instrument off.

The gas inlet is protected by a hydrophobic filter.

It is accessed by:
1. Detach any probe assembly
2. Twist and remove filter cap
3. Remove and replace filter disc
4. Check “O” ring inside cap
5. Replace filter cap
6. Performed flow block test

Additional filters are located in each of the accessory probe assemblies.
Operation and Field Use

To activate instrument push POWER button. The following warm-up sequence will occur:

1. Warm-up sequence (a-i) with info below.
   a. Logo
   b. Serial Number
   c. Revision
   d. System Check
      i. LED check
      ii. Backlight check
      iii. Date/Time
   e. Cal due (upcoming) or Cal Past Due
   f. Activation Acknowledgments
      i. Pump
      ii. Dataglog
      iii. GPS
   g. Sensor warm-up (7-10Min) and “Please Wait”
   h. Autozero
   i. Working display

2. Attach the appropriate probe assembly and perform a flow block check. An alarm sound, display indication and flow icon will indicate a failed test.

3. Follow company procedures for performing leak survey/investigation

4. If the alarm setting has been exceeded press and release the “A” button to disable the alarm. The alarm sound will automatically reset when the concentration has gone below the threshold value. Secondary alarms at higher concentration will activate when values are exceeded. Press and release the “A” button again to mute secondary alarms. During any alarm, the display back light will be RED in color.

5. Check filters daily for best results.

6. Battery power is displayed using a battery voltage icon. Full battery is 12.0v. BAT LOW VOLT will be displayed at 8v when insufficient battery power is available.

7. To turn off or put into standby mode push and hold the “A” button. It will display “SHUT DOWN” on left side and “STAND BY” on right side of the display. Press the ‘A’ button to turn the instrument off. Press ‘C’ to put unit in standby mode which will reduce power consumption and will allow you to reduce the warm up time to approximately two minutes. We recommend using stand by mode for less than 1 hour.
QUICK MENU

Press and release ‘B’ button. This will provide access to the following functions. Press the “C” button to scroll through the options. Use ‘B’ button to select. Use ‘B’ button again to turn it OFF or ‘C’ button to turn ON. Press ‘A’ button to select your choice and exit menu.

1. TICK – Audible leak detection mode. NOTE: Activating the tick will disable sound alarm.
   a. When activated a tick will be heard every second. Frequency of tick will increase as gas concentration increase.
   b. Press and release ‘B’ button will reset the tick frequency to 1 tick per second. The tick frequency will increase if gas concentration increase from that concentration.
   c. To turn the tick off, press and release ‘A’ button. Press and release ‘A’ button again to activate the alarm sound.

When viewing the following selections Use ‘B’ button to select. Use ‘B’ button again to turn it OFF or ‘C’ button to turn ON. Press ‘A’ button to select your choice and exit menu.

2. BH Test – Bar hole test function
3. PUMP - Use ‘B’ button to select. Use ‘B’ button again to turn it OFF or ‘C’ button to turn ON. Press ‘A’ button to select your choice and exit menu.
4. GPS – Real time GPS X/Y coordinates
5. SmartLink - Use Bluetooth to download logs (Calibration, Quick Cal, Session, Barhole, Autologs)
6. Warning - Use this feature to list current failure mode.

Bluetooth Activation

When the Bluetooth is activated the display readings can be transmitted to any device capable of receiving Bluetooth data. The data may also be viewed by using “Hyper Terminal”. The website is www.lgraeve.com

Bluetooth Passkey: 5 Digit Serial Number

Serial Communications Settings:
Bits Per Second: 57600
Data bits: 8
Parity: None
Stop bits: 1
Flow control: None

DataStream can be adjusted to send data every 1-10 sec. you can find settings to change this in Expert Menu -> DataStream. You need to turn DataStream ON in User Menu.

Once connected to the Bluetooth device, PMD sends the 7 digit PPM reading.
USER MENU

To access the user menu push and hold the “B” button until USER MENU is displayed. From this menu the following features can be viewed by pressing the “C” button to scroll through the options. Enter the selection by pressing the “B” button and adjusting by using the “C” button or the onscreen prompts. Pressing the “A” button repeated will return you to the working display.

Date and Time          View the date and time.
                        Time is in 24 hour format. Date is mm/dd/yy format.

Print Menu             Allows access to print menu for calibration and operational sessions.

Bump Test              Perform timed test for gas response in ppm range. Pump may be
                        selected ON or OFF for this function.

Calib Menu             Calibration to Zero Air, 1000ppm, 2.5% and 100% methane gas concentrations.
                        For instruction refer to CALIBRATION section of this manual.
                        • Zero Air - To Set Zero Point
                          Pump On / Off
                          Onscreen Instruction
                        • 1000PPM - To calibrate 1000ppm level only
                          (Zero Air calibration required first - automatic)
                        • 2.5% V/V - to Cal 2.5% (50 LEL) CH₄ Only
                          (Zero Air calibration required first - automatic)
                        • 100% V/V - to Cal 100% (100 LEL) CH₄ Only
                          (Zero Air calibration required first - automatic)
                        • Full Calib - Automatically sequence zero, 1000, 2.5% V/V, 100% V/V
                          (This updates Cal Due)

Datalog                Activates the data logging system. (If Activated w/memory card)

Data Stream            Activates real time data streaming of display readings every second to

Alarm PPM              Adjustment for PPM alarm value.
                        Setting at 0 disables alarm.
                        Range is 0-500ppm

Set Clock              Adjust date and time.

View Sess Log          View manually saved data.

View BHLOG             View the bar hole test logs (If Activated).

View Auto              View Autolog data of operational peak values.

View Cal Log           View calibration log.

QCal Log               View recording of individual calibration (Not Full Calib)
**Calibration Check**

To verify the proper operation of this instrument apply a known concentration of 50-1000ppm methane to the sample system prior to use.

This is not a required process but is recommended if the product has not been used for more than 30 days.

**Calibration**

The PMD requires calibration every 3 months. An automatic reminder will notify the user that calibration is due at start up.

Calibration can only be performed if the instrument has been operational for 30 minutes.

To calibrate the area must be known to be gas free. If there is methane in the area a bottle of zero air will be necessary. Other gases required include 1000ppm, 2.5% and 100% methane (pipeline gas is also acceptable). Some gases can be calibrated individually. Contact SENSIT Technologies Service Department for more information.

Calibration is performed with the pump off if there is no access to demand flow regulators for the calibration bottles. Turn-off is selected prior to calibration.

Calibration is performed through the User Menu. Using the “B” button access the User Menu. Use the “C” button to scroll to “Calib Menu”.

To begin press the “B” button. If the instrument has not operated for 30 minutes a countdown timer in seconds will be displayed. When the proper amount of time has been met the display will show “Proceed”. Press any button. A beep will be heard.

Select Cal Type and follow on-screen prompts. Full Calib is recommended.

Apply zero ppm methane or clean air. Press “C” button to begin zero air calibration. Display will show “waiting for stability” followed by “success” when completed. Press any button to continue.

Display will read “please apply 1000ppm methane”. Attach and apply 1000ppm methane. The process requires 1-5 minutes. Searching OPT TEMP will be displayed, then display will show “waiting for stability” followed by “success” when completed.

Display will read “please apply 2.5% methane”. Attach and apply 2.5% methane. The process requires 1-5 minutes. Display will show “waiting for stability” followed by “success” when completed.

Display will read “please apply 100% methane”. Attach and apply 100% methane. The process requires 1-5 minutes. Display will show “waiting for stability” followed by “success” when completed.

Upon completion press any key to exit to working display. Activate the pump and allow to clear prior to turning off. The calibration reminder will automatically update after successful calibration.
Contact Sensit Technologies to gain access to the following adjustable features not in the user menu.

<table>
<thead>
<tr>
<th>Service</th>
<th><strong>Contrast:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjust the display contrast as needed.</td>
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<table>
<thead>
<tr>
<th>Quick Scan:</th>
<th>Optimum Temp Adjust (1000ppm required)</th>
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<table>
<thead>
<tr>
<th>Orientation Cal:</th>
<th>Calibration of lamp output in different positions.</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Cal Flow:</th>
<th>Setting flow alarm</th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th>Tick SENS</th>
<th>Lo, Med, or High</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Alarm %LEL</th>
<th>Adjust the LEL alarm value. Default is 50%.</th>
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</thead>
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<table>
<thead>
<tr>
<th>Alarm %V/V</th>
<th>Adjust the point when the alarm deactivates. Default is 17%.</th>
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<table>
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<tr>
<th>Show SESS</th>
<th>Allow display of manually saved data. Default is off.</th>
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<table>
<thead>
<tr>
<th>Show BHLOG</th>
<th>Allow display of BH tests. Default is off</th>
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</table>

<table>
<thead>
<tr>
<th>Show AUTO</th>
<th>Allow display of Autolog data. Display is off.</th>
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<thead>
<tr>
<th>BH Time</th>
<th>Set the time in seconds for duration of the bar hole test. Default is 15 seconds.</th>
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<thead>
<tr>
<th>Purge Time</th>
<th>Set purge time for instrument prior to shut down. Default is 10 seconds.</th>
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<thead>
<tr>
<th>Standby</th>
<th>Time of inactivity or lack of motion in minutes that will cause the instrument to automatically go into low power mode. Default is off.</th>
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<tr>
<th>Shutdown</th>
<th>Time in minutes that shut down will occur when in standby mode. Default is 60.</th>
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<thead>
<tr>
<th>Bump Limit</th>
<th>Concentration of gas to be acceptable when performing a bump test. Range is 5 – 1000ppm. Default is 800. Set Lower and Upper Limit.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Bump Time</th>
<th>Time required in seconds for unit to pass a bump test. Range is 10-60. Default is 45.</th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th>Log Period</th>
<th>Time between Datalog points in seconds. Range 1-60. Default is 1.</th>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Data Stream</th>
<th>Time in seconds for data to be streamed through Bluetooth communication. Default if 1 second.</th>
</tr>
</thead>
</table>

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Adjustable Features (Continued)

Rest UCal  Reset cal data to factory settings (Password Protected)
Set Cal Due  Time Interval (90 Default)
Cal Due Ack  Requires button push after Cal Due reminder (default off)
DISP Callog  Last 5 calibration records
PPM Option:  PPM Auto range to LEL. Default is on.
PPM Handoff:  Handoff from PPM to LEL or %V/V setting. (default 5000)
% LEL Option:  LEL from 0.1-100%. Default is On
100% LEL Equiv:  Set LEL limits from 4.0 – 5.0% gas volume. Default is 5%.
PPM+%LEL:  Display both PPM and %LEL. Default is Off
NG Factor:  Automatic calculation for low methane pipeline gas. (default 100)
UCal Date  Date of last full user calibration
Erase Auto  Erase Autolog
Erase Sess  Erase manually saved data Log
Erase BHLog  Erase bar hole test log
SCal Pump  On/Off During Cal (for each gas type) when calibrating on the cal-station
RezeroREQD  Downdrift Alert, On/Off, Value 5 Default
Language  Select language for display
Auto Bump  Require bump test before use (default off, adjustable 1-30 days)
Erase Bump  Erase Auto Bump Log
Saving SD Card Data Log Information

Remove SD Memory Card from inside the battery compartment.
Install SD Memory Card in computer.
Save File in desired format and location. Preferred format is .kml

GPS Data Conversion & Coordinate Mapping

GPS Data conversion and mapping can be accomplished using Smart-Link Data Viewer Software and Google Earth or gpsvisualizer.com

1. Using SmartLink select the desired reports.
   (See “How to use” and “Reports” section of SmartLink Help file for more information.)

2. Click “Save Report” button. Save report as format .kml format.
   This format will only save log information for which valid GPS coordinate information is available.

3. Google Earth must be installed (Free Download).
   Double click the .kml file.
   It will open Google Earth and load the map.

   Note: If Google Earth is not installed, proceed to number 4.

4. Go to: http://www.gpsvisualizer.com/
   Select “Google Maps”.

   Import your .kml file:

   1. Using browse button, select the file you wish to view.

   2. Select the map type.

   Way-points: To display coordinates, gas concentration detected and time at specific locations. It is best to use with Session-log, Bar-hole log and Auto-log.

   Route points: The “route” would represent the road, trail, path, etc. that you have taken. It also display gas concentration detected and time at specific locations. It is best to use with Data-log to view area surveyed.

   3. Click “Draw the map” button.
GPS Data Conversion & Coordinate Mapping

Sample of the data log report is displayed below.
Warranty

Your Sensit PMD is warranted to be free from defects in materials and workmanship for a period of two years after purchase (excluding calibration). If within the warranty period the instrument should become inoperative from such defects the instrument will be repaired or replaced at our option. This warranty covers normal use and does not cover damage which occurs in shipment or failure which results from alteration, tampering, accident, misuse, abuse, neglect or improper maintenance. Proof of purchase may be required before warranty is rendered. Units out of warranty will be repaired for a service charge. Internal repair or maintenance must be performed by a Sensit Technologies authorized technician. Violation will void the warranty. Units must be returned postpaid, insured and to the attention of the service department for warranty or repair.

This warranty gives you specific legal rights and you may have other rights which vary from state to state.

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